Electron Reflection

Suppose electron travels at c, what is its wavelength

$$p = \hbar k = \frac{h}{\lambda}$$

$$\lambda = \frac{h}{mc} = \frac{6.63 \times 10^{-34}\ J \cdot s}{(9.11 \times 10^{-31} kg)(3 \times 10^{8} m/s)}$$

$$= 2 \times 10^{-12}\ m$$

Suppose $\lambda = 1mm$, what is v

$$p = mv = \frac{h}{\lambda}$$

$$v = \frac{h}{m\lambda} = \frac{6.63 \times 10^{-34}\ J \cdot s}{(9.11 \times 10^{-31} kg)(0.001 m)}$$

$$= 0.7\ m/s$$

$$E = \frac{1}{2} m v^2 = 2.41 \times 10^{-31} \text{ J}$$

If $E = e \Delta V$

$$\Delta V = 1.5 \times 10^{-12} \text{ V}$$

So at $v \sim c$, our approximation of a step barrier is very bad.

For $m = 1 \text{ kg}$, $v = 10 \text{ m/s}$ (a classical thing)

$$\lambda = \frac{h}{mv} = 6.6 \times 10^{-35} \text{ m}$$

our approximation is worse.